Programming for Cognitive and Brain Science Development of model and parameter recovery procedures for the study of reversal learning: Plan

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The environment that human evolve in is rarely certain. Neuroeconomics and more specifically decision-making science aim at investigating how human learn from and make decisions in such an uncertain environment (Loewenstein, Rick, & Cohen, 2008). Uncertain environments may be characterised by their changing properties over time, known as environmental volatility.

Learning in a volatile environment has interestingly been studied through reversal learning tasks in which participants are classically brought to learn and discriminate the rewarding value of two outcomes which changes or *reverses* over time (the high-valued outcome become the low-valued one, and conversely) – and may be asked to further use this knowledge to guide decision.

A subpart of the general population clinically diagnosed as obsessive-compulsive disorder (OCD) patients[1], show impaired performance in such reversal tasks (in contrast to the non-OCD participants) (Vaghi et al., 2017). Briefly, though OCD patients accurately track the change of the environment and correctly update their confidence according to it, they seem not to translate their knowledge into correct action. A further question arises whether OCD-patients' impaired performance under uncertainty is dependent on their active role in the task: do OCD patients show the previously observed impairment in both perceptual (i.e., as passive 'observers' of the environment) and reward-guided decisions (i.e., as 'agents' actively sampling and interacting with the environment)?

To address this question, a reversal learning task previously developed in the laboratory and a theoretical Bayesian model (Glaze, Kable, & Gold, 2015) are used to compare perceptual (cue-based) and reward-guided (outcome-based) learning in tightly matched condition. Specifically, participants are asked to

[1]Shortly, OCD is psychiatric disorder characterised by the presence of obsessions (recurrent, persistent and anxiety-causing thoughts and urges that the individuals attempt to control through compulsions) and/or compulsions (rituals, repetitive behaviours or mental acts that the individuals follow to neutralise the obsessions) (Association et al., 2013).

track the changing cause of visual stimuli: either basket (orange apple basket vs. blue apple basket) which presented apples are drawn from (cue-based condition), or the action (left vs. right) which draws apples from a target basket (outcome-based condition).

The very first step of this study is to comply with recent recommendations in cognitive modelling (Heathcote, Brown, & Wagenmakers, 2015; Palminteri, Wyart, & Koechlin, 2017). Summarily, the use of computational model in cognitive science has grown over the last decade: a legitimate growing interest regarding the ability of such models to highlight and disentangle interactions of the hidden cognitive processes that result in human behaviour. Following this trend, the risk of caveat has also increased possibly leading to useless, or worse, misleading conclusions: typically when models are not *falsified*, checked for their ability to account for actual data or when their parameters are not recovered. Three steps will therefore be detailed as follows: First, parameters of interest (learning error and the probability of reversal) will be recovered, their variance will be studied by varying the experimental conditions: number of participants, actual parameter values (those which test datasets are simulated from). Of interest, the extent to which the model is able to estimate a difference in the values of one parameter depending on its actual (different) values will be emphasised. Second, potential mutual influence (correlation) between the two parameters will be investigated and third, particularly relevant model fit will be displayed and commented.

Practically, the scripts for the present model recovery procedure will be written in a MATLAB LiveScript, using MATLAB (The MathWorks, Inc., 2017) and saved in the following Git repository: `https\github.com_ModelRecovery_TLANDRON`.

References

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